THE RUGOSE CORAL *PALAEOPHYLLUM* BILLINGS FROM THE ORDOVICIAN OF CENTRAL NEW SOUTH WALES

B. D. Webby
Department of Geology and Geophysics, University of Sydney

(Plates viii, ix)

[Accepted for publication 16th February 1972]

Synopsis

Three new species of *Palaeophyllum* are described from Ordovician limestones of central New South Wales. They range through horizons of broadly Eastonian to Lower Bolindian age. Two distinct types of budding are well displayed—in the species from the upper part of the Cliefden Caves Limestone, axial and parricidal, and in the species from the top of the Malachi's Hill Beds, peripheral and non-parricidal.

Introduction

The first species of *Palaeophyllum* to make its appearance in the Ordovician successions of central New South Wales is *P. proliferum* sp. nov. It occurs in the upper part of the Cliefden Caves Limestone and the upper part of the Regan's Creek Limestone, and in the middle part of the Bowan Park Limestone (now referred to the Quondong Formation of the Bowan Park Group by Semeniuk, 1970). These occurrences belong to Fauna II of Webby (1969), and seem to represent a Lower Eastonian or Upper Gisbornian? age. Associated with *P. proliferum* in the upper part of the Cliefden Caves Limestone and the Quondong Formation are two species of *Hillophyllum* (Webby, 1971). *Palaeophyllum*, though probably not the same species, has been noted by Webby (1969, p. 642) as occurring in Ordovician limestone near Gunningbland, in association with *Streptelasma*, *Plasmoporella inflata* Hill and *Cliefdenella etheridgei* Webby.

A second species, *P. crassum* sp. nov., comes from the upper part of the Cargo Creek Limestone. It is associated with *Quepora calamus* Webby and Semeniuk and streptelasmatids, underlying the main fossiliferous bands containing massive *Favistina* and favositids. Another species of *Palaeophyllum* occurs in the upper part of the Ballingoole Formation of the Bowan Park Group and, though poorly preserved, yet another in the upper part of the Canomodine Limestone. All these occurrences seem to belong to Fauna III, and to be of Upper Eastonian age.

The Bowan Park Group is succeeded by the Malachi's Hill Beds (Semeniuk, 1970). Towards the top of the formation locally derived limestone pebbles contain an abundant coral fauna including *P. macrocaule* sp. nov., *Favistina*, *Catenipora* and many favositids. Succeeding massive limestones yield a similar fauna which shows little sign of reworking. The graptolites in the lower part of the Malachi's Hill Beds have suggested to Semeniuk an age near the Eastonian/Bolindian boundary or Lower Bolindian, which implies that the overlying coral fauna may have a Bolindian age. It possibly represents the youngest Ordovician coral assemblage in central New South Wales, and constitutes a fourth biostratigraphic assemblage (Fauna IV) typified by abundant favositids, *Favistina*-like forms and the first appearance of *Catenipora*. *Calapoecia*, recorded from an isolated limestone lens near Boree Creek, west of Bowan Park (Stevens, 1956), may also come from this stratigraphic level.

Strusz (1960, 1961) described a species of *Palaeophyllum* from limestone beds at the top of the Oakdale Formation in the Oakdale Anticline of the Mumbil

area, near Wellington. He referred it to *P. rugosum* Billings, and considered it to belong to a topmost Ordovician or Lower Silurian horizon. The species is associated with *Tryplasma lonsdalei* Etheridge, *T. derrengullenense?* Etheridge and *Nipponophyllum* aff. *giganteum* Sugiyama. A second species, *Palaeophyllum* sp. nov. ?, is reported by Strusz from the base of the overlying Narragal Limestone (late Llandoverian-Wenlockian). Packham (1968, p. 154), however, has noted that these basal beds of the Narragal Limestone are separated from the main body of the limestone by a thin succession of acid-intermediate volcanics, and either form the uppermost part of the Oakdale Formation or consist of another unit resting on the Oakdale. Packham (1969, p. 103) has viewed the coral fauna of the Oakdale Formation with its *Palaeophyllum*, *Syringopora* and genera related to *Halysites* as apparently of late Eastonian-Bolindian age. He (1969, p. 83) has observed a similar limestone 15 miles south of Strusz's area containing halysitids, *Multisolenia* sp., *Heliolites daintreei* Nicholson and Etheridge and *Syringopora* sp., and underlying shales with an Eastonian graptolite assemblage.

In contrast, Ivanovskij (1965) has regarded the rugose element of Strusz's Oakdale fauna as characteristic of the late Llandoverian or even transitional Llandoverian-Wenlockian, and Webby and Semeniuk (1969, p. 357) have favoured a Lower Silurian rather than an Upper Ordovician age because of the much greater generic and specific diversity of the halysitids than in typical Ordovician occurrences. Apart from the occurrence of *Palaeophyllum*, there is little in common between the Oakdale coral fauna and the confirmed Ordovician coral faunas of New South Wales. But then there is also a remarkable lack of similarity between the rugose element of the Oakdale fauna and the Lower Silurian faunas of the Bridge Creek Limestone, Quarry Creek Limestone and Rosyth Limestone being studied by R. A. McLean (pers. comm.).

The presence of an " advanced " dissepimented rugosan like *Nipponophyllum* and species of *Tryplasma* (*sensu stricto*) clearly indicates that the Oakdale coral fauna is no older than Ashgillian (i.e., Upper Bolindian). It is either younger than the coral fauna at the top of the Malachi's Hill Beds and older than the Bridge Creek Limestone (possibly Upper Bolindian) or, alternatively, younger than the Bridge Creek, Quarry Creek and Rosyth Limestones and older than the Narragal and Borenore Limestones (about late Llandoverian or transitional Llandoverian-Wenlockian, as Ivanovskij has already advocated). It is difficult to reconcile Packham's occurrence of *Multisolenia* underlying an Eastonian graptolite horizon when the genus has not been confirmed in the large bodies of Ordovician (mainly Eastonian) limestone of the region.

In addition to the occurrences in central New South Wales, *Palaeophyllum* has been recorded from the Trelawney Beds of northern New South Wales (Philip, 1966), and from near the top of the Gordon Limestone in the Florentine valley of Tasmania (Banks, 1965).

Catalogue numbers of specimens in the University of Sydney palaeontological collections have the prefix SUP.

Systematic Descriptions

Suborder Columnariina Rominger 1876

Family Stuariidae Milne-Edwards and Haime 1850

Genus *Palaeophyllum* Billings 1858

Type species. *P. rugosum* Billings 1858.

Discussion. Dorothy Hill (1961) has redescribed the type material of *P. rugosum*, and has given a revised diagnosis of the genus. From present observations, the genus exhibits more than one type of budding, and therefore the statement " peripheral, non-parricidal increase " should be omitted from the diagnosis. In *P. gracile* Flower 1961 and *P. proliferum* sp. nov., axial, parricidal budding

is represented, and in *P. rugosum* Strusz 1961, *non* Billings 1858, peripheral, quadripartite, parricidal budding. *P. aggregatum* (Nicholson and Etheridge, 1878), judging from Wang's (1948, p. 102, text-fig. 3*b*) illustration, and a thin section in the Sedgwick Museum (SM.A. 7544*c*), Cambridge, shows tripartite and quadripartite, parricidal increase. Also, apparently lateral, non-parricidal division is exhibited by *P. humei* Sinclair 1961 and possibly in the type species, *P. rugosum* Billings 1858 (Hill, 1961, p. 2).

Ivanovskij (1969) has recently lumped all the known species of *Palaeophyllum* into three species—*P. thomi* (Hall, 1857), *P. fasciculum* (Kutorga, 1837) and *P. lebediensis* (Čerepnina, 1960), the first two each having an additional variant, *P. thomi* var. *cateniforme* Flower 1961 and *P. fasciculum* var. *halysitoides* Troedsson 1928, respectively. The species are distinguished by the nature of septa and tabulae. *P. thomi* has rudimentary minor septa and updomed tabulae with axial sag, and *P. fasciculum* has well-developed minor septa and updomed tabulae with a flat axial zone. *P. lebediensis* has long major septa—usually longer than in the other two species—almost always reaching the axis, well-developed minor septa, updomed tabulae, sometimes with axial depression, and numerous tabellae. The species are very broadly conceived and would be much better regarded as species groups. Indeed, they appear to have some value in such a broad grouping. The *P. thomi* group is a cosmopolitan Middle-Upper Ordovician group, the *P. fasciculum* group, a cosmopolitan Upper Ordovician-Lower Silurian group, and the *P. lebediensis* group, a geographically restricted Upper Ordovician group. Of the New South Wales species, *P. proliferum* and probably *P. crassum* belong to the *P. thomi* group, and *P. macrocaule*, to the *P. lebediensis* group. This latter occurrence extends the range of the *P. lebediensis* group from the Siberian Platform, Gornaja Šorija and Gornyj Altai to central New South Wales. *P. rugosum* Strusz 1961, *non* Billings 1858, which differs from the type species in exhibiting peripheral, quadripartite, parricidal budding, in having slightly longer minor septa and typically flat to updomed axial portions of tabulae, seems to belong to the *P. fasciculum* group.

Palaeophyllum proliferum sp. nov.

Plate VIII, figs 1–11

Material. One unsilicified specimen (SUP 43231) comes from the upper part of the Cliefden Caves Limestone, Trilobite Hill, and another (SUP 43230), from the same horizon at the Island. Silicified material comprises six specimens (SUP 43243–45, 43271–73) from the upper part of the Cliefden Caves Limestone, Licking Hole Creek, eight specimens (SUP 29136, 43246–48, 43267–70) from the Quondong Formation, Quondong, and three specimens (SUP 28150–52) from the upper part of the Regan's Creek Limestone. Holotype is SUP 43231 ; other numbered specimens designated paratypes.

Description. The large phaceloid corallum of the holotype is up to 220 mm. across and 150 mm. high. Within the corallum there are small patches of fused (cerioid) corallites and areas showing a cateniform character. Smaller colonies, especially the silicified specimens, are more strictly dendroid. Fine, transverse growth lines, and relatively narrow, shallow, vertical septal grooves and broad, gently raised interseptal ridges are exhibited on external surfaces of some silicified specimens (SUP 29136, 43244). Frequent budding of individual corallites in both larger and smaller coralla is observed. Up to five buds may develop at a particular level (Pl. VIII, fig. 11), but more often two, three or four (Pl. VIII, figs 1, 3, 5–6, 8). Increase is predominantly axial and parricidal, though in a few transverse sections there is also a suggestion of lateral budding (Pl. VIII, fig. 5). Possible rejuvenescence is seen in one corallite (SUP 43243). The calice is moderately deep, steep sided and has a floor which is gently updomed, with a

relatively broad, axial depression, to flat. Individual corallites vary in size from 1·5 to 6 mm. in diameter, usually ranging from 2·5 to 5 mm. (on average 3·6–3·9 mm.). Long major septa and very short minor septa are developed, the latter only now and then seen to extend beyond the peripheral stereozone. The major septa most frequently extend to near the axis without touching, leaving an axial space of about 1 mm. But they exhibit considerable variability, sometimes meeting at the axis, and occasionally being quite short and rudimentary. The number of major septa range from 12 to 22, usually 15 to 19 (on average 16–17). The peripheral stereozone is of varying thickness, from 0·1 to 0·6 mm., usually 0·2–0·3 mm., and formed from dilatated peripheral ends of septa and intervening fibrous tissue. The stereozone of a particular corallite usually retains a constant thickness, but, in longitudinal section of the calice, is seen to gradually taper from the calical floor to the top of the calical wall. A number of corallites, especially those in contact, show irregularities in shape, sometimes including prominent attenuations of the corallite wall around adjacent corallites (Pl. VIII, fig. 5). A few corallites exhibit transverse processes, up to 2·5 mm. long, which are suggestive of rudimentary connecting processes. Altogether there seems to be a remarkable degree of plasticity in size and shape of the corallites of this species, and most active budding.

Tabulae are updomed, with prominent axial depression, to flat, spaced from 6 to 10 in 5 mm. vertically. They are mainly complete, but there are also a few incomplete tabulae (tabellae) usually near or associated with a division. Tabulae become irregular and incomplete, even absent altogether, in areas of active increase. The width of the axial depression is from 1·0 to 1·5 mm.

Remarks. The species of *Palaeophyllum* from Ordovician limestone near Gunningbland (Webby, 1969, p. 642), previously thought to possibly be conspecific with *P. proliferum*, is now regarded as distinct. Specimens (SUP 43261–63) of the Gunningbland species have similar dimensions, but differ in having more widely spaced corallites and much less prominent budding.

P. proliferum appears to have closest affinities to *P. thomi* (Hall, 1857) from the " Richmond formation " of El Paso, Texas, and the Aleman Formation of the Montoya Group, New Mexico (Hill, 1959 ; Flower, 1961). However, *P. proliferum* exhibits more variability in the size and shape of the corallites and different budding. Also, in *P. proliferum*, a corallite of 5 mm. diameter has on average 19–21 major septa, whereas in *P. thomi* a corallite of the same dimensions has 21–23 major septa.

Palaeophyllum crassum sp. nov.

Plate IX, figs 1–3

Material. Holotype (SUP 43237) from tributary on the south-east side of Canomodine Creek, in the upper part of the Cargo Creek Limestone.

Description. The corallum is dendroid-phaceloid, more than 85 mm. across and 25 mm. high. Corallites are mainly from 6 to 12 mm. in diameter (on average 8–9 mm.). Septa are of two orders, the major usually extending to 0·5–1·2 mm. of the axis, and seem to form, with the downturned tabulae, an aulos-like structure, from 1 to 3 mm. across. The minor septa vary from barely protruding beyond the septal stereozone to extending about 1 mm. in from the margin of the stereozone. The total number of septa is from 44 to 54 (on average 48–50). The peripheral stereozone ranges from 0·5 to 1·1 mm. (usually 0·7–0·8 mm.) thick, and seems to be formed from thickening of septa at their bases with intervening fibrous tissue. Long, slightly wavy, major septa are developed, which thin markedly just inside stereozone, and then taper more gradually towards inner ends.

There is a tendency for the development of well differentiated axial and peripheral regions, the axial region occupying about one-fifth to one-third of the total corallite diameter. Tabulae are mainly complete, gently arched across broad peripheral region with slight downturn at peripheral edge, and more sharply flexed across U-shaped axial depression. Occasional incomplete tabulae occur, and are usually restricted to peripheral areas and margins of the axial depression. Tabulae are spaced from 7 to 10 in 5 mm. vertically, with slightly more in peripheral regions (9–11) than in axial areas (7–9), due to the additional incomplete tabulae in peripheral areas. Many of the complete and incomplete tabulae meet or almost join in the downward flexure at the margin of the axial depression, forming, together with the inner ends of the major septa, the aulos-like structure.

Remarks. A poorly preserved species of *Palaeophyllum* from the upper part of the Canomodine Limestone, on the south bank of the Belubula River, east of Cranky Rock, compares with *P. crassum* but, as the specimen (SUP 43264) shows, it has much longer minor septa. A different species occurs in the upper part of the Ballingoole Formation, Bowan Park Group, at Malachi's Hill. As seen in the specimen (SUP 29131), it may be distinguished from *P. crassum* in having less prominent minor septa, and updomed, mainly complete tabulae, more or less flat in the axial region and steeply inclined peripherally.

Possibly, *P. crassum* bears the closest relationships with the type species, *P. rugosum* Billings 1858, from a Black River or lowermost Trenton horizon at Lake St. John, Little Discharge, Canada (Hill, 1959, 1961). However, the New South Wales species is slightly larger, with a thicker stereozone, it has relatively more septa, and a more prominent axial, aulos-like structure involving the major septa and tabulae.

Palaeophyllum macrocaule sp. nov.

Plate IX, figs 4–10

Material. Six specimens (SUP 43233–36, 43274–75) from limestone and one specimen (SUP 29130) from underlying breccias at the top of the Malachi's Hill Beds, north-east of Malachi's Hill. Holotype is SUP 43236 ; other numbered specimens designated paratypes.

Description. The corallum is phaceloid, up to 170 mm. across and 185 mm. high. Peripheral, non-parricidal budding well represented (Pl. IX, figs 6, 8), usually one bud at a time, but in one specimen (SUP 43274), two peripheral buds developed in adjacent quadrants of the corallite. The calice appears to be steep sided and moderately deep, with an updomed floor. Corallites are variable in size, from 2·5 to 7·0 mm. in diameter (on average 4·5 mm.). The septa are differentiated into major and minor, the major commonly extending to near the axis, but may reach the axis or, on the other hand, may barely extend beyond one-half the distance to the axis. In some corallites, especially those with larger diameters and major septa reduced in length, one septum, possibly the cardinal, may be elongated to form an axial, columella-like structure (Pl. IX, figs 5, 9). These blade-like axial structures are not consistently aligned in one direction within an individual corallum, perhaps implying that they do not consistently form from the same (cardinal?) septum unless, during growth, there is some rotation of individual corallites. This long septum tends to be more dilatated in the axial region than in the periaxial region, and occasionally it appears to be fused with the opposite septum. Sometimes, because of thinning in the periaxial region, it almost appears as an isolated element. The total number of septa is from 28 to 46 (on average 38–40). Major and minor septa are much dilatated in the peripheral zone. They taper rapidly just inside the peripheral

stereozone, and then more gradually towards their inner ends. The stereozone is formed from the thickening of peripheral edges of septa and possibly intervening fibrous tissue. In specimens exhibiting smaller corallites, the peripheral stereozone is usually 0·2–0·4 mm. thick, in larger corallites, 0·5–0·6 mm. thick. The minor septa are of variable length, typically nearly one-half the length of the major.

Tabulae are close spaced, having a gently to steeply updomed form. Both complete and incomplete tabulae are represented. In one corallite of the holotype, some 45 mm. high, the tabulae exhibit variation from very gently convex to highly domed forms, these latter sometimes exhibiting a shallow, narrow, axial depression, 1·0 to 1·5 mm. wide, and narrow peripheral troughs (Pl. IX, fig. 4). In another specimen (SUP 29130), the tall domes change to low domal and flat (even slightly sagging) forms. Incomplete tabulae are commonly developed and may be situated axially or peripherally. They are usually of variable size. From 8 to 13 tabulae are spaced in 5 mm. vertically (on average 10–11 in 5 mm.).

Remarks. Although in the material studied it seems possible to recognize larger and smaller varieties, graphical representation of plots of corallite diameter and number of septa shows a fairly even spread of values and no pronounced twofold concentration. The thicker peripheral stereozone (0·5–0·6 mm.) and columella-like axial structure may have developed to strengthen the colonies with larger corallites.

A specimen (SUP 43232) of the species of *Palaeophyllum* from the Trelawney Beds of northern New South Wales compares with *P. macrocaule*, having corallites with a similar diameter and septal number, but with very short minor septa, barely protruding beyond the peripheral zone, major septa usually almost meeting at the axis without an axial structure, and flatter tabulae, especially in peripheral regions, and slightly wider spacing (9–10 in 5 mm. vertically).

Ivanovskij's (1969) *P.* ex gr. *lebediensis* from the Upper Ordovician (Ashgillian) of the Siberian Platform bears a number of basic differences from the type material of *P. lebediensis* described by Čerepnina (1960) from the Upper Ordovician of Gornyj Altai and Gornaja Šorija. Čerepnina described *P. lebediensis* as having a corallite diameter of 10–18 mm., septa of two orders, the major numbering from 35 to 47 (though in her figured specimens of larger corallites, from 9–11 mm. in diameter, I have only counted 31–33 major septa), and tabulae spaced 5–6 in 5 mm. vertically. On the other hand, Ivanovskij (1969, pl. 10, fig. 2*a-b*) depicted a form from the Siberian Platform having corallites of 5·5–7·0 mm. diameter, 21–23 major septa, minor septa barely showing, and tabulae much more closely spaced (9–12 in 5 mm.), including many incomplete elements. This form seems to be a quite distinct species, though it should be retained in the *P. lebediensis* species group. It bears very close resemblances to *P. macrocaule*, differing only in lacking the columella-like axial element and in having less well developed minor septa.

Acknowledgement

The author has been assisted by funds from the Australian Research Grants Committee and a Sydney University Research Grant.

References

Banks, M. R., 1965.—East, Central, North-west and West Tasmania. *In* Smith, E. M., and Williams, E. (Eds.), *Geological Excursions for the Australian and New Zealand Association for the Advancement of Science*. 38th Congress, 16–20 August 1965. Pp. 35–44. Dept. Mines Tasm., Hobart.

Billings, E., 1858.—Report for the year 1857. *Geol. Surv. Canada, Rept. Prog., 1857.*, pp. 147–192.

Čerepnina, S. K., 1960.—Podklass Tetracoralla (Rugosa). *In* Khalfin, L. L. (Ed.), Biostratigrafija paleozoja Sajano-Altajskoj Gornoj oblasti. Tom I, Nižnij Paleozoj. *Tr. sib. naučno-issled. Inst. Geol. Geofiz. miner. Syr.*, 19 : 387–393.

Flower, R. H., 1961.—Part I. Montoya and related colonial corals. *Mem. Bur. Min. Res. New Mexico*, 7 : 1–97.

Hall, J., 1857.—Geology and Palaeontology of the Boundary. *In* Emory, W. H., *United States and Mexican Boundary Survey Report*, 1 (2), pp. 101–140, 167–174, pl. 20. Washington.

Hill, D., 1959.—Some Ordovician corals from New Mexico, Arizona, and Texas. *Bull. Bur. Min. Res. New Mexico*, 64 : 1–25.

————, 1961.—On the Ordovician corals *Palaeophyllum rugosum* Billings and *Nyctopora billingsii* Nicholson. *Geol. Surv., Canada, Bull.*, 80 : 1–7.

Ivanovskij, A. B., 1965.—Stratigrafičeskij i paleobiogeografičeskij obzor rugoz ordovika i silura. *Inst. Geol. Geofiz. Sib. Otd. AN. SSSR.*, pp. 1–119.

————, 1969.—Korally semejstv Tryplasmatidae i Cyathophylloididae (Rugozy). *Inst. Geol. Geofiz. Sib. Otd. AN. SSSR.*, pp. 1–112.

Kutorga, S., 1837.—*Zweiter Beitrag zur Geognosie und Paläontologie Dorpat's und seiner nächsten Umgebungen*, pp. 1–51. St. Petersburg.

Nicholson, H. A., and Etheridge, R., 1878.—A monograph of the Silurian fossils of the Girvan district in Ayrshire. Vol. I, Fasc. I, pp. 1–135. Edinburgh and London.

Packham, G. H., 1968.—The Lower and Middle Palaeozoic stratigraphy and sedimentary tectonics of the Sofala-Hill End-Euchareena region, N.S.W. Proc. Linn. Soc. N.S.W., 93 : 111–163.

————, 1969.—Ordovician system. The geology of New South Wales. *J. geol. Soc. Aust.*, 16 : 76–103.

Philip, G. M., 1966.—The occurrence and paleogeographic significance of Ordovician strata in Northern New South Wales. *Aust. J. Sci.*, 29 : 112–113.

Semeniuk, V., 1970.—The Lower-Middle Palaeozoic stratigraphy of the Bowan Park area, Central-Western New South Wales. *J. Proc. Roy. Soc. N.S.W.*, 103 : 15–30.

Sinclair, G. W., 1961.—Notes on some Ordovician corals. *Geol. Surv. Canada, Bull.*, 80 : 9–18.

Stevens, N. C., 1956.—Further notes on the Ordovician formations of Central Western New South Wales. *J. Proc. Roy. Soc. N.S.W.*, 90 : 44–50.

Strusz, D. L., 1960.—The geology of the parish of Mumbil, near Wellington, N.S.W. *J. Proc. Roy. Soc. N.S.W.*, 93 : 127–136.

————, 1961.—Lower Palaeozoic corals from New South Wales. *Palaeontology*, 4 : 334–361.

Troedsson, G. T., 1928.—On the Middle and Upper Ordovician faunas of northern Greenland, Part II. *Meddel. om Grønland*, 72. 198 pp.

Wang, H. C., 1948.—Notes on some rugose corals in the Gray collection, from Girvan, Scotland. *Geol. Mag.*, 85 : 97–106.

Webby, B. D., 1969.—Ordovician stromatoporoids from New South Wales. *Palaeontology*, 12 : 637–662.

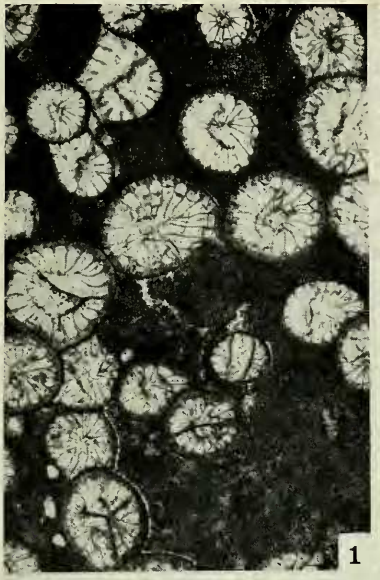
————, 1971.—The new Ordovician genus *Hillophyllum* and the early history of rugose corals with acanthine septa. *Lethaea*, 4 : 153–168.

———— and Semeniuk, V., 1969.—Ordovician halysitid corals from New South Wales. *Lethaea*, 2 : 345–360.

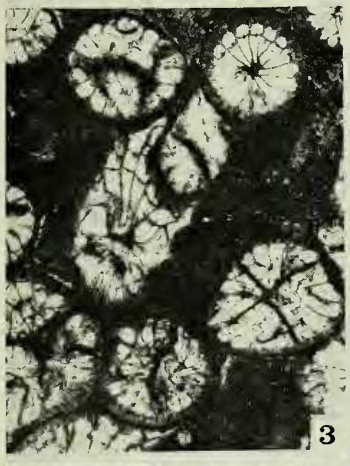
EXPLANATION OF PLATES

Plate viii

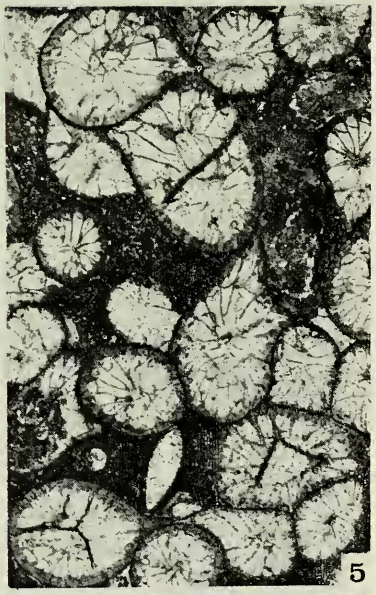
Figs 1–11. *Palaeophyllum proliferum* sp. nov. 1–5, SUP 43231, holotype, upper part of the Cliefden Caves Limestone, Trilobite Hill. 1, transverse section, ×3, showing bipartite and tripartite parricidal increase. 2, longitudinal section, ×3, exhibiting axial, parricidal division. Note variability of the tabulae, including irregular, incomplete forms in areas of active budding. 3, transverse section, ×4, showing bipartite and quadripartite mode of budding. 4, longitudinal section, ×4, showing typical form of tabulae. 5, transverse section, ×4, illustrating bipartite and tripartite, parricidal increase, and irregular, attenuated shape of some corallites in contact. 6–9, silicified specimens, paratypes, from Quondong Formation, Quondong. 6, SUP 43246, ×2, oblique view showing budding with " daughter " corallites not occupying entirely all the space of the original " mother " corallite. 7, SUP 43247, ×2, side view of branching colony. 8–9, SUP 43248, top and side views of specimen showing quadripartite division. Note the four " daughter " corallites do not occupy entirely the space of the former " mother " corallite. 8, ×3. 9, ×2. 10–11, silicified specimens, paratypes, from upper part of Cliefden Caves Limestone, Licking Hole Creek, ×2. 10, oblique view of a colony encrusted by a heliolitid coral. 11, oblique-side view of dendroid colony. Note the branch at the right produces five buds.


1


2


3


4

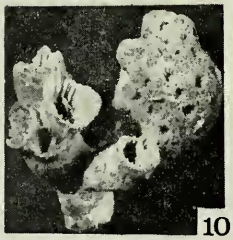

5

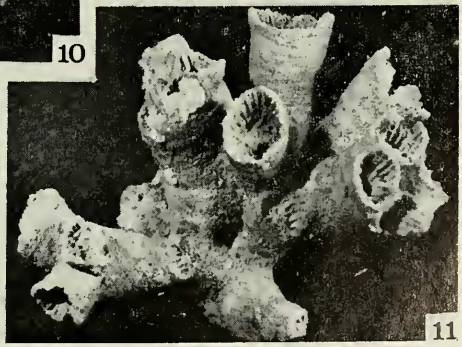

6


7


8


9


10


11